



Accuracy of Bracket Transfer With Two Indirect Bonding Techniques

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KEYWORDS

*Transfer accuracy,
Indirect bonding, Bracket,
3Dscanning, tooth movement.*

ABSTRACT

Aim: to measure the accuracy of brackets transfer with two indirect bonding techniques using three dimensional scanning. **Subjects and Methods:** Two hundred brackets were bonded to twenty subjects (upper arch) receiving orthodontic treatments. Orthodontic brackets were placed on the casts with a specific water soluble adhesive. After bracket placement, three dimensional scans of the casts obtained. Two types of transfer trays were fabricated, and used to bracket transfer to patient's teeth. After bracket transfer another three dimensional scans of the subjects obtained. The teeth on one model will be then digitally superimposed to the corresponding teeth on the other model. All data collected will be tabulated and statistically analyzed. **Results:** The indirect bonding methods for both groups that were used in this study were precise and dependable within acceptable limits with directional bias especially toward gingival direction. **Conclusion:** Single sheet vacuum formed techniques were significantly less accurate than duple sheet vacuum formed technique in the Occluso-gingival direction.

INTRODUCTION

As all branches of dentistry, orthodontics is constantly developing to improve efficiency and quality. Outcome of orthodontic treatment affected by numerous variables including errors in bracket placement, wire selection, wire bending, manufacturer tolerances, variations in adhesive thickness, operator fatigue and Acuity, and the ability to monitor treatment.^{1,2}

With straight wire orthodontic appliances, an accurate bracket positioning is the most important step. If the bracket positioned correctly, tooth movement can be achieved in correct and fast manner. If it not placed in correct position; we can't avoid errors in first, second, and third order expression.³

The steps of treatment improve the case gradually from beginning to finishing. Therefore, if there are no errors during treatment procedures,

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we will achieve good finishing with less work. There are transverse, vertical and horizontal factors to be considered to finishing.^{4,5}

The pre-adjusted orthodontic appliance is based on the concept that accurate bracket placement will adjust tooth positions in all three planes of space during treatment. Placement of a bracket in incorrect position can cause deviations in all orthodontic tooth movements.⁶

Using recent technologies in orthodontics began since long time. Nowadays orthodontics become more dependent on new technologies.⁷

By using radiographs, practice management software, three dimensional scanners and diagnostic models; orthodontics translated to a completely digital format. Every company is trying to find the next big innovation, because the digital work is continuously devolved. As all branches of science, orthodontics undergo technological development to reduce human errors thus enhancing both treatment timing and results.⁸

Orthodontic attachments are bonded by to mechanics the first is direct and other is indirect on casts and then transferred to the teeth.

IDB technique made by two-stage process of bracket positioning on a cast and transfer of these brackets to the patient's mouth by a transfer tray, where they are bonded to the pretreated enamel surface. IDB technique has been refined and variations described as new materials or techniques have become available.^{9,10}

PATIENTS AND METHODS

Subjects selected from orthodontic clinic at Faculty of Dentistry Al-Azhar University, Asyut branch. The selected subjects presented with sound maxillary ten teeth from last premolar right to last premolar left. Two hundred brackets were bonded to twenty subjects (upper arch) receiving orthodontic treatments, were included in the study.

Group (1) Thermoplasting vacuum formed tray (single sheet)

Full-arch impressions of upper and lower arches with high quality alginate impression material, following the manufacturer instructions were taken. Then, dental casts were obtained with type IV dental stone.

Guidelines for bracket positioning were drawn on the previously fabricated casts

Long axis lines: vertical line representing the long axis of the tooth which located at the center of the crown.

Marginal ridge lines: joining the mesial and distal marginal ridges of the buccal surface of molars and premolars.

Bracket slot lines: starting from the first molar at the level of buccal fossae. By using a drawing divider, the distance between the marginal ridge line and bracket slot line in the first maxillary molar was determined and replicated on the other molars and premolars. With the bracket placement marker gauge the height of bracket slot of anterior teeth were calculated. We can use reference tables to determine bracket height of incisors and canines.

This position may vary according to the vertical malocclusion and on the anatomy of teeth.

Brackets placed on the casts with a small amount of water soluble Glue. 3-D scans of the casts were then obtained with a 3 shape scanner.

The Thermoplasting vacuum formed tray (single sheet) manufactured using vacuum former, a 1-mm thick single hard sheet of Ethylene Vinyl Acetate on the plaster model with brackets in position, and trimmed. The plaster model with tray immersed for 15 minutes in water to dissolve the glue, detached from casts and adhesive remnants removed. The trays were then trimmed then vertical slits cut on the tray.



Tooth surfaces etched with 37% phosphoric acid during 20 seconds, and then washed for 20 seconds. Bonding area isolated with cheek retractors, cotton rolls and dry thoroughly.

Light cure adhesive applied to tooth surface and bracket base. The tray carefully positioned over teeth then light-cure bracket edges for 10 seconds.

Firm tray removed by a smooth tip metal instrument. 3D scans of the upper arch were obtained after bonding of brackets.

For each patient, two 3-D virtual models were obtained from the 3D scan data, the corresponding teeth on both models were then digitally superimposed using a 3 shape software.

After superimposition, any differences in bracket position were provided by software.

Clinically acceptable differences to conceder are; linear differences of <0.5 mm and angular

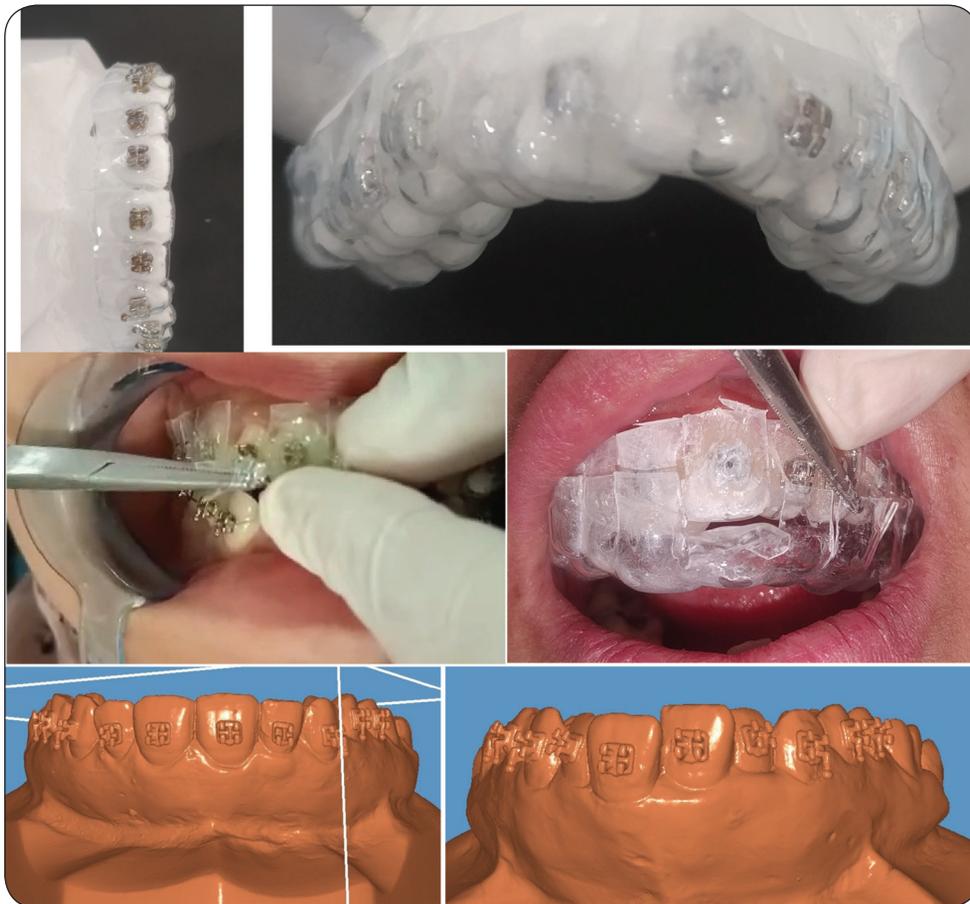
differences of $<2^\circ$. After a washout period of 3 weeks, 36 tooth pairs were selected randomly from the original sample and the measurements repeated to assess repeatability.

Group (2) Thermoplasting vacuum formed tray (duple sheets)

The same steps of impression taking , casting, bracket guidelines drawing, bracket positioning and 3D scan of the bracket setup on dental cast the same as group (1)

The transfer tray manufactured using a vacuum former, thermoform a 1-mm thick soft sheet of Ethylene Vinyl Acetate over the cast, then another 1-mm thick hard sheet of Vinyl Acetate over the soft one, trimmed then vertical slits cut on the tray.

The tray immersed in water, detached from casts and adhesive remnants removed the same as group (1).



Light cure adhesive applied and light curing the same as group (1).

Tray removal, 3D scanning and superimposition the same as group (1).

RESULTS

Linear measurements:

Vertical Dimension (Occluso-gingival):

Both groups showed accurate measurements (<0.5mm), the higher accuracy found in (Group1/ single sheet VF) group, while the least accuracy was found in (Group2 /duple sheets VF) group.

Horizontal Dimension (Mesio-distal):

Both groups showed accurate measurements (<0.5mm), the higher accuracy was found in (Group1/ single sheet VF) group, while the least accuracy was found in (Group2 / duple sheets VF) group.

Table (1): The mean, standard deviation (SD) values of Linear measurements of both groups.

Variables	Linear measurements			
	Vertical dimension		Horizontal dimension	
	Mean	SD	Mean	SD
Group1/single sheet VF	0.1006 ^b	0.0245	0.0899 ^b	0.0059
Group2/duple sheets VF	0.1206 ^a	0.0152	0.1467 ^a	0.0208
<i>p-value</i>	0.004*		<0.001*	

Means with different l letters in the same column indicate statistically significance difference.*; significant (p<0.05) ns; non-significant (p>0.05)

Angular measurements:

Tipping:

Both groups showed accurate measurements (< 2 degrees), the higher accuracy was found in (Group1/ single sheet VF) group, while the least accuracy was found in (Group2 / duple sheets VF) group.

Rotation:

Both groups showed accurate measurements (< 2 degrees), the higher accuracy was found in (Group1/ single sheet VF) group, while the least accuracy was found in (Group2 / duple sheets VF) group.

Table (2): The mean, standard deviation (SD) values of Angular measurements of both groups.

Variables	Angular measurements			
	Tipping		Rotation	
	Mean	SD	Mean	SD
Group1/ single sheet VF	0.8554 ^b	0.1834	1.1578 ^b	0.0903
Group2/ duple sheets VF	0.9554 ^a	0.0568	1.2074 ^a	0.0487
<i>p-value</i>	0.025*		0.037*	

Means with different l letters in the same column indicate statistically significance difference.

*;significant (p<0.05) ns; non-significant (p>0.05)

DISCUSSION

Unlike direct bonding the indirect bonding methods have been developed to aid the orthodontist in accurate positioning of brackets without many of the clinical challenges experienced with direct bonding.^{1,2.}

A lot of previous studies have been interested in compare indirect bonding method to direct bonding one in term of bracket bond failure, bond strength, clinical effevecencies and accuracy of bracket positioning.



These previous studies reported that there is no statistically significant difference between both techniques however IDB method more accurate in bracket positioning^{4,6,10,13,14}.

Assuming perfect impression and plaster model pouring techniques, Not occurring of enamel attrition, inter proximal cutting, or

Any other dental pathological factors that could alter the shape of tooth or its crown so working models served as controls for their corresponding patient models for bracket position measurement.^{7,8,9,12}

Transferring considered the main issue of IDB technique so that tray materials have direct influence on accuracy of bracket transfer. Multiple materials used for transferring some of them are silicone based and others are resin based. In this study Thermoplastic formed trays single and duple sheets were selected as it considered from more recent applied transferring methods^{5,15,16,18}.

In this study linear measurements in horizontal dimension (mesiodistally) and vertical dimension (occlusogingival) and angular measurements tipping of the root and rotation were measured to assess directional bias and frequency of error during bracket transferring procedure.

The methods used in the study measure indirect bonding transfer errors in-vivo with digital three dimensional scanning. Using of digitally acquired 3-D surface data of bracket positioning errors allows for precise and repeatable measurements in all dimensions otherwise photographically acquired image data.^{11,17}

This study aims at showing if the brackets can be transferred accurately from their position on the casts to the exact position in the patient's teeth or not. This study not only clarify positional accuracy in the direction of brackets, but also measured frequency of indirect bonding errors.

The collected data reinforce the null hypothesis that there is no *statistical* difference between the

position of brackets on plaster model and their position on patients teeth.

CONCLUSION

The two IDB methods used in this study *were accurate and reliable*, with transfer errors less than the acceptable limits of +/- 0.5 mm linearly and 2.0° angularly.

When the two techniques were compared, bracket transfer accuracy was comparable for the single sheet technique.

Duple sheet technique was significantly less accurate in the O-G direction.

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قياس دقة نقل حوامل التقويم باستخدام طريقتين من طرق الارتباط غير المباشر

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الملخص:

الهدف: الغرض من هذه الدراسة قياس دقة نقل حوامل التقويم باستخدام طريقتين من طرق الارتباط الغير مباشر باستخدام المسح الضوئي ثلاثي الأبعاد.

المواد والاساليب: أجريت الدراسة علي عدد مائتين من عوالب التقويم تم تركيبهم لعدد عشرون مريضاً. وضعت عوالب التقويم علي قوالب الأسنان باستخدام مادة لاصقة تذوب في الماء . -تم إجراء مسح ضوئي ثلاثي الأبعاد لقوالب الأسنان, تم تصنيع نوعين من الحوامل الناقلة لعوالب التقويم لأسنان المرضى, بعد نقل العوالب تم إجراء مسح ضوئي اخر ثلاثي الأبعاد للأسنان , تم مطابقة المسحين الضوئيين رقمياً, تم تجميع البيانات وجدولتها وتحليلها احصائياً.

النتائج: أظهرت الدراسة أنه يوجد فروق احصائية بين المجموعتين

الخلاصة: أظهرت الدراسة أن حوامل التقويم احادية الطبقات أقل دقة من حوامل التقويم ثنائية الطبقات في الإجهاد الإطباقى اللثوى

الكلمات المفتاحية: دقة نقل . الارتباط الغير مباشر . حوامل التقويم . مسح ثلاثي الأبعاد, حركه الاسنان .